When do Denali golden eagles migrate?

Adult eagles arrive in Denali National Park and Preserve by late March or early April, although some may come back earlier. Subadults (only 1 year old) come back later; they may not even start the return migration north until late April.

Golden eaglets usually hatch in mid to late May or early June. When the chicks are about 70 -75 days (not quite 2 1/2 months) old they are ready to start learning to fly. The *fledglings* (eaglets learning to fly) remain in their *natal areas* (the area where they were born, their nest area) for four to eight weeks after fledging. During this time, they are dependent upon their parents for food and protection from predators and they spend most of their time exercising their muscles and learning to fly. They learn to fly independent of each other and their parents. In late September or early October, when the eaglets are about 4 months old, they leave their natal areas and begin their southward migration completely independent of their parents. The success of their trip rests on their adaptations to migration.

Where do the eagles go?

Our *telemetry* (radio tracking) studies indicate that many of the golden eagles of Denali spend winters in the Lower 48 states of the US. They may travel as far east as Kansas and South Dakota and as far south as northern Mexico. Many of Denali's golden eagles spend their winters along the Rocky Mountains of Montana and Wyoming and Colorado.

Our research suggests that the fledglings do not leave Denali when their parents do, and the eagles travel alone. The fledglings find their way south on their own. The eagles take similar paths, but no two studied have been quite the same. How do they know where they are aiming for? We don't know exactly, but other scientists suggest that genetics plays a large role in migration.

It takes most juvenile golden eagles from Denali from four to nine weeks to complete their first southward and northward migrations. Adult golden eagles probably migrate faster and take more direct routes than do juveniles and subadults.

What adaptations do golden eagles have for migration?

Golden eagles, and all other migratory birds, have physical and behavioral adaptations for migration. The physical adaptations are how their bodies are designed to make long flight possible, and the behavioral adaptations include how the eagles use their physical adaptations.

Physical Adaptations: Golden eagles are well adapted to flight. The eaglets have obviously adapted for rapid growth so that within four short months they progress from being an egg to migrating upwards of 2000 to 4000 miles. Their lungs and the hemoglobin in their blood are very efficient and help them get extra oxygen to their muscles. They usually have a lightweight, yet strong, skeleton with hollow bones. Their internal organs are smaller to lighten their body weight. Even with these amazing adaptations, flight is one of the most costly means of transportation and there are other adaptations necessary for migration.

Gliding and powered flight (flapping) are the two basic types of bird flight. Gliding flight, where the wings are held outstretched from the body and no flapping occurs, is the simpler and uses less energy. The wings are moved so that more or less surface area is exposed during a glide. Soaring flight is gliding in circles. The way that a gliding or soaring eagle gains altitude is to find updrafts, including *thermals* - warm air that rises and can carry the bird along with it. In powered flight, the bird flaps its wings up and down to provide *lift* (the force that keeps the bird flying instead of falling) and *thrust* (the force that moves the bird forward through the air). During migration, golden eagles use both gliding and powered flight.

Flying uses a lot of energy. Whether or not an eagle is successful in migration depends on many factors, but it cannot be successful if it burns more energy in flying than it has stored in fat and can eat along the way. Powered flight "costs" much more energy than gliding, and is more costly to large birds than small birds, because of their larger weight and wing size. This is probably why large birds use gliding flight as much as possible. Migration using powered flight almost doubles the amount of energy a bird needs each day. Wing shape and size also affect the energy cost of flight. Birds with long, pointed wings generate more power with less energy than birds with short, rounded wings.

Flight involves more than simply whether a bird glides or flaps. Wing span, wing shape, wing area, tail area, tail length, mass, and musculature are all important in how a bird flies. *Wing span* is the distance between the tips of the outstretched wings. *Wing area* is the surface area of the wings that comes in contact with the air. Likewise, *tail area* is the area of the tail that comes in contact with the air. Golden eagles have large wings, large tails, and huge flight muscles in their breast. Because of these features, they are capable of flying at high altitudes and for very long distances.

During gliding and soaring, golden eagles constantly adjust their wing and tail area by opening and closing their wings and tail feathers. For the slowest glides, as in soaring, the wings are held out as far from the body as possible to increase surface area. Greater wing and tail area also increase lift, which is needed at slow speeds. At faster speeds, the wings and tail are closed a bit, resulting in a smaller wing span, wing area, and tail area. During the fastest cross-country glides, the tail is closed and the wings are sometimes drawn in to just over half of the maximum wingspan. This decreases the drag that results from breaking through the air with the leading edge of the wings and tail, and from the friction of air flowing across the wings and tail.

The ability of hawks and eagles to use lift explains how soaring migrants can complete migration even though they may fly slowly. Hawks and eagles are adapted to use even the smallest and weakest of thermals. With this ability, they are able to lift off in the morning and land late in the day, getting in many hours of flight with relatively little energy. When thermals are not available, hawks and eagles resort to powered flight. Thus, weather conditions affect migration strategies of these species. Overall, golden eagles are energy-efficient migrants and they soar and glide during much of their migratory journeys by taking advantage of air currents and thermals along the way.

Energy: The energy needed for migration comes from food eaten before and during migration. As a bird flies, it first uses sugars available in the blood and liver, just like people do when they are exercising. This energy will last for a short time and then the bird uses its fat deposits. To fly long distances a bird must carry lots of fat. Gram for gram, fat is the most energy-rich substance

that animals produce and store. For the same weight, fat has about twice as many calories of energy as the same amount of carbohydrate or protein. Without fat a migrating golden eagle cannot fly far or survive long periods of time. The amount of fat a bird deposits before migration varies by species. For instance, shorebirds seem to deposit the largest migratory fat stores with the average being about 66% and a range of 50 to 100%. This means that some species double their lean weight before migrating. Hawks and eagles rarely deposit more than about 15% of their body weight in fat.

Juvenile golden eagles probably store fat before they leave their nesting areas while their parents are still providing them with food. Once they leave their nesting areas they are traveling over unfamiliar ground and their hunting success is probably low. Because golden eagles use gliding flight during migration they may not need to store as much fat as powered fliers like sparrows and geese. When their fat runs low, they need to find food along their migratory routes. Researchers suggest that *carrion* (animals that are already dead) is probably a common food source for migrating juvenile golden eagles. If a bird depletes its fat deposits, it resorts to burning the protein in its muscles. The breast muscle, which is critical for using its wings, becomes smaller, the bird flies slower, and eventually it dies.

Behavioral Adaptations: The behavioral adaptations include type of flight (flapping vs gliding), flight speed, altitude, flight direction, and seasonal timing. Migrating birds must decide how fast to fly, how high to fly and which direction to fly. For example, a golden eagle must decide when to glide and when to flap. Golden eagles must decide how fast to fly. If it flies too fast, it will use energy faster, and it may run out of fat. If an eagle flies too slowly it may not complete its migration. Studies show that migrating birds adjust their flight speed to either minimize the energy they use or maximize how far they travel. By flying faster in headwinds and slower in tailwinds, a migrating golden eagle can increase the distance it travels. Golden eagles that complete migration, probably select speeds that promote a fast yet energy-efficient migration.

Do the golden eagles return to Denali next summer? Why?

Adult golden eagles that are members of the breeding population probably return to or near Denali each year to nest. Their offspring, however, return to Alaska but generally do not return to the park in their first few years of life. Golden eagles are long-lived birds and it usually takes four to five years from them to reach sexual maturity. During their first years of life, they may travel great distances in search of food supplies. Once they are four or five years old, they may spend more time near Denali in search of a mate and a nesting territory.

Sources:

A Gathering of Angels by Kenneth Able. Comstock Books.

How Birds Migrate by Paul Kerlinger. Stackpole Books.

Flight Strategies of Migrating Hawks by Paul Kerlinger. University of Chicago Press.

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